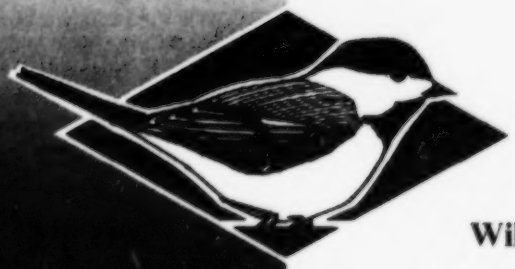
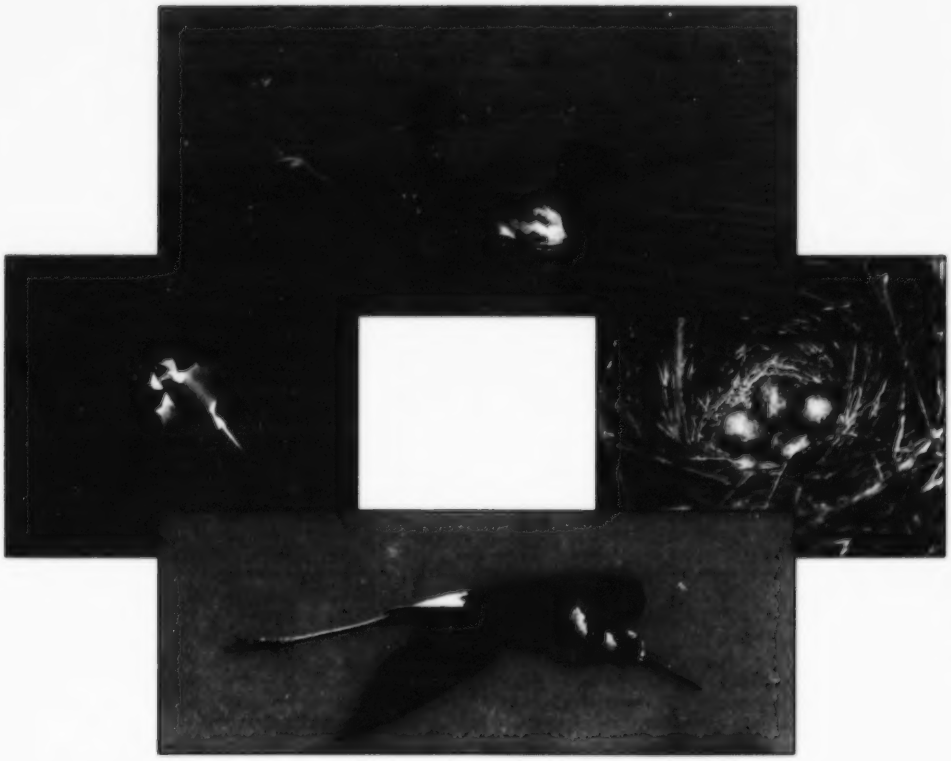


Fish & Wildlife Division

SPECIES AT RISK

Wildlife Survey of the Antelope Creek Habitat Development Area 2007



Alberta Species at Risk Report No. 118

Alberta

Wildlife Survey of the Antelope Creek Habitat Development Area – 2007

Jennifer Carpenter

Joel Nicholson

Alberta Species at Risk Report No. 118

March 2008

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT
Fish & Wildlife

ANTELOPE CREEK
HABITAT DEVELOPMENT AREA

Publication No.:
ISBN: 978-0-7785-7013-4 (Printed Edition)
ISBN: 978-0-7785-7014-1 (On-line Edition)
ISSN: 1496-7219 (Printed Edition)
ISSN: 1496-7146 (On-line Edition)

Cover Photographs: J. Carpenter (clockwise from top: Lesser scaup, Baird's sparrow nest, black-necked stilt, American white pelican).

For copies of this report, contact:

Alberta Sustainable Resource Development
Information Centre
Main Floor, Great West Life Building
9920-108 Street NW
Edmonton, Alberta, Canada T5K 2M4
Telephone: (780) 422-2079

OR

Visit our web site at:
http://www.srd.gov.ab.ca/fishwildlife/speciesatrisk/

This publication may be cited as:
Carpenter, J.E. and J.T. Nicholson. 2008. Wildlife Survey of the Antelope Creek Habitat Development Area - 2007. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 118, Edmonton, AB. 23 pp.

Table of Contents

Acknowledgements iii
Executive Summary iv
1. Introduction 1
2. Methods 2
  2.1 Avian point counts 3
  2.2 Amphibian call surveys 4
  3.3 Burrowing owl playback surveys 5
  3.4 Raptor and shrike survey 5
  3.5 Incidental monitoring 5
3. Species Observations 5
  3.1 Birds 5
  3.2 Amphibians 8
  3.3 Mammals 8
  3.4 Other observations 9
4. Discussion and Recommendations 10
  4.1 Wetland habitats 10
  4.2 Upland habitats 11
  4.3 Noise 13
  4.4 Monitoring strategy 14
References 15
Appendix I. 18
Appendix II. 20
Appendix III. 21
Appendix IV 22
Appendix V. 23

Table of Figures

Table 2.0.1. General locations and names of the fields that are discussed in this report.

Table 2.1.1. Total number of upland and wetland point count plots in each field.

Table 3.1.1. Sensitive avian species recorded during surveys of the ACHDA.

Table 3.2.1. Amphibian species recorded during surveys.

Table 3.3.1. Mammal species recorded during the survey and in previous records.

ACKNOWLEDGEMENTS

We express thanks to several individuals and organizations that benefited this project. The Antelope Creek Habitat Development Area (ACHDA) provided funding for the 2007 wildlife survey. Fieldwork was conducted under an Alberta Fish and Wildlife Division Research Permit (# 21932). Shannon Burnard and Neal Wilson (ranch managers for the ACHDA) provided valuable information of previous wildlife observations and facilitated this work with their extensive knowledge of the ranch. We also thank Walter Hohloch for allowing access to land north of the ACHDA. Lee Bell (Alberta Fish and Game Association) administered the financial aspect of the project. Joel Nicholson (Alberta Sustainable Resource Development, Fish and Wildlife Division) provided a game caller with burrowing owl calls. Nicola Koper (Natural Resources Institute, University of Manitoba) provided pre-existing point count locations from research conducted between 2000 and 2002 on portions of the ranch. Danielle Cross (Alberta Sustainable Resource Development, Fish and Wildlife Division) and Neal Wilson (ACHDA) provided valuable comments on a draft of the manuscript.

EXECUTIVE SUMMARY

The Antelope Creek Habitat Development Area (ACHDA), located west of Brooks, Alberta, is a working ranch cooperatively managed by multiple partners. An objective of the ACHDA is to balance the needs of multiple land uses while also promoting wildlife habitat. To assess species occurrence on the ranch and collect baseline wildlife data, wildlife surveys were conducted from 15 June to 30 June 2007 and included avian point counts, amphibian call surveys, burrowing owl playback surveys, shrike and hawk searches, and incidental observation. Eighty-two wildlife species were seen or heard during the surveys, including 72 bird, seven mammal, and three amphibian species. Twenty-eight species at risk were seen or heard, including four 'may be at risk', 22 'sensitive', and two of 'undetermined' status. Many of these species are strongly associated with prairie wetlands or native mixed-grass prairie uplands. These surveys are one element in long-term monitoring to evaluate changes in the relative abundance and diversity of wildlife on the ranch.

1. INTRODUCTION

The Antelope Creek Habitat Development Area (ACHDA) is a ranch that aims through cooperation with multiple agencies to balance the needs of livestock, wildlife, and the oil and gas industry (DUC 2007). Established in 1986, the ACHDA encompasses a >22 km^2 area about 10 km west of Brooks, Alberta (DUC 2007). Founding partners for the ranch included the Alberta Fish and Wildlife Division, Wildlife Habitat Canada, Ducks Unlimited Canada and the Alberta Fish and Game Association. Through cooperative efforts, a multitude of other organizations and individuals have contributed to the ACHDA, including: Alberta Environment; Alberta Public Lands Division; the Eastern Irrigation District; and the Universities of Alberta, Lethbridge and Calgary (DUC 2007).

The ACHDA is composed primarily of dry mixed-grass prairie but also contains some tame pasture and several managed wetlands. These wetlands and their associated riparian areas provide a mosaic of upland and wetland habitat that supports multiple prairie-dependent wildlife species. Upland prairie habitat in this region is dominated by needle and thread (*Stipa comata*) and blue grama grass (*Bouteloua gracilis*) with patches of prickly pear (*Opuntia polyacantha*), ball cactus (*Coryphantha vivipara*) and sagebrush (*Artemisia cana*) dispersed throughout (Guyn and Clark 1999, Koper and Schmiegelow 2006b).

There are several substantial water bodies within the ACHDA, including Lake San Francisco and 36 constructed wetland basins managed by Ducks Unlimited Canada (DUC 2007). In addition, there are many smaller ephemeral water bodies, including: the canals that connect managed basins; spillover from these canal systems; spillover from managed basins; and natural depressions. The fringes of wetland basins and canals are typically dominated by common cattail (*Typha latifolia*), spike rush (*Eleocharis palustris*) and great bulrush (*Scirpus acutus*) (Koper and Schmiegelow 2006b). In some locations, wetlands are bordered by salty mudflats edged by foxtail (*Hordeum jubatum*). While there are generally few trees and shrubs in the area, willow (*Salix* spp.), silver buffaloberry (*Shepherdia argentea*), and a few stands of aspen (*Populus tremuloides*) can be found in wetter areas, mainly along canals.

The ACHDA is primarily used for livestock grazing, however, petroleum extraction is significant, particularly on the eastern portion of the ranch. This development has generated an extensive network of roads throughout the eastern portion of the ranch. Recreational use and public access of the ranch is encouraged, and there are posted maps, designated parking areas, and a public access road that loops through the ranch. Other than this designated route, public access is by foot only.

The purpose of the 2007 wildlife survey was to provide information to ACHDA managers regarding wildlife occurrence on the ranch. This information will be used to (1) to guide current management and planning efforts, particularly those beneficial to sensitive species, and (2) evaluate changes in the relative abundance and diversity of wildlife on the ranch as one element in long term monitoring.

2. METHODS

Methods for the wildlife surveys generally followed those outlined in the 2005 Sensitive Species Inventory Guidelines (SSIG), published by Alberta Sustainable Resource Development and Fish and Wildlife (2005). All surveys took place between 15 June and 30 June 2007 in weather conditions with no precipitation and wind speeds less than 20 km/h. Following the SSIG, species at risk in this report include: (1) species determined to be endangered or threatened under Alberta's *Wildlife Act*; (2) species of special concern following a provincial detailed status assessment by the Alberta Endangered Species Conservation Committee (ESCC) and (3) all species ranked by the 2005 general status assessment process as at risk, may be at risk, sensitive or undetermined. All observations of species made during surveys were submitted to the Fisheries and Wildlife Management Information System (FWMIS).

For survey purposes, the ranch was divided along pre-existing fence line divisions. Fields were labeled following Table 2.0.1. Five fields of native mixed-grass prairie are labeled field 1, field 2, field 3, field 4 and Cassil's field. A 6th smaller field with continual grazing is labeled the grazed field. Two additional areas, managed without grazing for nesting cover, are labeled the NE idle, and NW idle field. An additional small field labeled home was also surveyed. Other areas of the ranch were not

extensively surveyed and included planted and irrigated fields, labeled the pivot and CWG fields. Some surveys were also conducted on land adjacent to the ACHDA, labeled Oakland's for this report.

Table 2.0.1. General locations and names of fields discussed in this report.

Field Name	General Location
Field 1	northwest
Field 2	northeast
Field 3	south
Field 4	southwest
Cassils	east
Grazed field	southeast
Home field	central
NE idle	northeast
NW idle	northwest
Oakland's	north of the ACHDA
Pivot and CWG fields	central and southeast

2.1 Avian point counts

Birds were surveyed using circular point counts (see Appendix III for locations). Points (n=104) were placed following Koper and Schmiegelow (2006a) with 100 m radius plots centred every 300 m along transects radiating from wetlands or roads. All point count plots were accessed by foot. The number of plots in each field was determined by field size and configuration (Table 2.1.1). Count duration was five minutes and was not limited to birds, with all species within the 100 m radius recorded. In addition, evidence of breeding activity (song, display, den or nesting behaviour) was noted. Upland point counts were centred at least 100 m from a wetland edge. Wetland point counts were made at the wetland edge and included all wetland habitats within a 100 m radius. Counts began after sunrise (~05:15) and concluded by 10:00. Most counts

were repeated after a seven day interval; however counts in Oakland's were conducted only once.

Table 2.1.1. Total number of upland and wetland point count plots and times counted in each field.

Field Name	Number of Count Plots		Times Counted
	Upland	Wetland	
Field 1	10	4	2
Field 2	8	6	2
Field 3	14	6	2
Field 4	13	3	2
Cassils	7	4	2
Grazed field	3	1	2
Home field	1	1	2
NE idle	1	1	2
NW idle	2	2	2
Oakland's	14	3	1
Total	73	31	

2.2 Amphibian call surveys

Call surveys for amphibians were located (1) at randomly selected points along wetland edges, and (2) at points along roads and trails near wetlands (see appendix V for locations). Points along roads and trails were selected based on proximity of the road or trail to a wetland. Call surveys took place after dark between 22:30 and 02:00 and followed the SSIG (section 1.7.2). After a delay of two minutes, a three minute survey was conducted. If sensitive species were heard, the site was revisited during the day and egg masses and tadpoles were searched for.

3.3 Burrowing owl playback surveys

Call playback surveys and associated ground searches were conducted at sites with (1) previous observations of burrowing owl (*Athene cunicularia*) activity, and (2) sites with suspected burrowing owl breeding activity. Call playback survey methodology followed the SSIG (section 4.7.1 and 4.7.2).

3.4 Raptor and shrike survey

Observers walked along canals and searched shrubby and treed areas for loggerhead shrike (*Lanius ludovicanus*) and raptor breeding activity. Silver buffaloberry (*Shepherdia argentea*) shrubs were observed first from a distance of >200 m with a spotting scope and then again at close range on foot for evidence of loggerhead shrikes. Areas with Swainson's hawk (*Buteo swainsoni*) circling and calling were searched for nest sites.

3.5 Incidental monitoring

All incidental observations of sensitive species were recorded during the study period. This included all observations made while walking or driving between sites, and while conducting other surveys. During avian point counts, sensitive species observed beyond the 100 m radius plot were recorded separately as incidentals.

3. Species Observations

A total of 82 wildlife species were observed (seen or heard) on the ACHDA during the 2007 surveys (see appendix I for complete species listing). These include 72 bird, seven mammal and three amphibian species. Of these, four are classified as 'may be at risk', 22 as 'sensitive' and two as of 'undetermined' status in Alberta (Alberta Sustainable Resource Development 2007).

3.1 Birds

Seventy-two bird species were observed and 26 bird sensitive species were located (table 3.1.1). Seventeen of these species are strongly associated with wetland

habitats and ten with native mixed-grass upland prairie. There was direct evidence that most of the sensitive bird species were actively breeding on the ACHDA through breeding displays or songs, observations of juveniles, nest defence behaviours or observation of active nests.

No burrowing owls were found during playback surveys. An active Swainson's hawk nest was located on the ranch in the NW idle field. A second nest was located in trees adjacent to the ranch. Both pairs of birds used the ACHDA extensively for foraging. Ferruginous hawks (*Buteo regalis*) were not observed during the survey and there are no prior records for ferruginous hawks on the ACHDA. In Alberta, ferruginous hawks are reliant on ground squirrel prey (Alberta Sustainable Resource Development and Alberta Conservation Association 2006) and the low number of ground squirrels on the ACHDA likely precludes Ferruginous hawks. A few silver buffaloberry shrubs grew along canals and also near the wetlands in the NW and NE idle fields. Loggerhead shrikes were located in both the NE idle and NW idle fields near these shrubs.

Table 3.1.1. Sensitive avian species recorded during surveys of the ACHDA. Primary habitat association is listed although many species require both upland and wetland habitats.

Species Name	Primary Habitat	Evidence of Breeding	Evidence of Foraging	Status
Baird's Sparrow	upland	✓	✓	May Be At Risk
Barn Swallow	upland		✓	Sensitive
Bobolink	upland	✓	✓	Sensitive
Grasshopper Sparrow	upland	✓	✓	Sensitive
Loggerhead Shrike	upland		✓	Sensitive*
Long-billed curlew	upland		✓	Sensitive*
Short-eared Owl	upland	✓	✓	May be at risk
Sprauge's Pipit	upland	✓	✓	Sensitive*
Swainson's Hawk	upland	✓	✓	Sensitive
Upland Sandpiper	upland		✓	Sensitive
American Bittern	wetland	✓	✓	Sensitive
American Green-winged Teal	wetland	✓	✓	Sensitive
American White Pelican	wetland		✓	Sensitive
Black Tern	wetland	✓	✓	Sensitive
Black-crowned Night Heron	wetland	✓	✓	Sensitive
Black-necked Stilt	wetland	✓	✓	Sensitive
Common Yellowthroat	wetland	✓	✓	Sensitive
Forster's tern	wetland		✓	Sensitive
Great Blue Heron	wetland		✓	Sensitive
Lesser Scaup	wetland	✓	✓	Sensitive
Northern Harrier	wetland	✓	✓	Sensitive
Northern Pintail	wetland	✓	✓	Sensitive
Pied-billed grebe	wetland		✓	Sensitive
Sora	wetland	✓	✓	Sensitive
Virginia Rail	wetland	✓	✓	Undetermined
Yellow Rail	wetland	✓	✓	Undetermined

Nomenclature and status follow The General Status of Alberta Wild Species 2005 (Alberta Sustainable Resource Development 2007)

* Denotes a status of Special Concern, following a detailed status assessment by the ESCC (Alberta Sustainable Resource Development 2007b).

3.2 Amphibians

Three species of amphibians were located during wildlife surveys (Table 3.2.1). Heavy rains fell on the first and seventh day of the project and all amphibian call surveys took place within 4 days of those rainfalls. Plains spadefoot toad (*Spea bombifrons*) calls were heard at five separate sites in field 4. Of these, 3 sites were located along the shallow ephemeral overflow leading south and east from the most southern wetland in field 4. Two sites were located in ephemeral overflow in the central wetland in field 4. Plains spadefoot toads were also heard at one site just east of the largest wetland in field 1, again in an overflow. The number of toads heard at each site was between two or three. No evidence of plains spadefoot toad eggs or tadpoles could be found during the day, however such searches are often difficult and call surveys are a more accurate indicator of breeding activity.

Table 3.2.1. Amphibian species recorded during surveys. Amphibians were detected through both nighttime call surveys and daytime searches.

Species Name	Breeding Calls	Individual(s) Located	Status
Tiger Salamander		✓	Secure
Boreal Chorus Frog	✓	✓	Secure
Plains Spadefoot Toad	✓		May Be at Risk

3.3 Mammals

Six mammal species were observed during general and incidental surveys (Table 3.3.1). A long-tailed weasel (*Mustela frenata*) was observed in the southeast corner of field 4. In addition, there are other records on the ACHDA for the American badger (*Taxidea taxus*) and pronghorn (*Antilocaptra Americana*) (Alberta Sustainable Resource Development, unpublished data). No specific effort was made to survey for small mammals and those expected in the area are not designated as sensitive (see Appendix II).

Table 3.3.1. Mammal species recorded during the survey and in other records (Alberta Sustainable Resource Development, unpublished data).

Species Name	Observed	General Status
Long-tailed Weasel	✓	May be at Risk
Pronghorn	2005/2008	Sensitive
American Badger	2005	Sensitive
Coyote	✓	Secure
Muskrat	✓	Secure
Red Fox	✓	Secure
Richardson's Ground Squirrel	✓	Secure
White-tailed Deer	✓	Secure
White-tailed Jackrabbit	✓	Secure

3.4 Other observations

While conducting general surveys, industrial noise in field 3 could be heard at all point count locations and was often cumulative, with noise coming from multiple sources and directions. In field 3, noise was also heard from sources south of the ACHDA boundary. Furthermore, in Cassil's field, noise was heard from across San Francisco Lake. Particularly in field 3, this noise disrupted survey efforts by reducing the ability to hear bird and amphibian songs and calls.

4. Discussion and Recommendations

4.1 Wetland habitats

It is important to manage and conserve wetland basins to alleviate the overall loss of wetland habitat across the prairie (Gibbs 2000). This is supported by survey results on the ACHDA. Nineteen of the sensitive species observed are of important conservation status primarily because of their dependence on disappearing wetland habitats (Alberta Sustainable Resource Development 2007).

Local habitat characteristics are important for wetland species distributions (Murkin et al. 1997, Koper and Schmeigelow 2006a). Responses of one species to habitat characteristics may not be the same for another species (Koper and Schmeigelow 2006b). Thus, maintenance of a diversity of wetland sizes and types across the ACHDA benefits a variety of sensitive wildlife species. The ACHDA supports both ephemeral and permanent wetlands of variable size with shorelines that range from muddy and exposed to densely vegetated with cattail and bulrush. The largest wetland, Lake San Francisco, borders the ACHDA and has a thick contiguous wetland fringe. Koper and Schmeigelow (2006a) identify thick wetland fringe as important in models for songbird richness and abundance (Koper and Schmiegelow 2006a). Sightings of juveniles indicate Lake San Francisco is an important breeding habitat for black-crowned night herons (*Nycticorax nyticorax*), and calling indicates its importance to other sensitive species, such as the American bittern (*Porzana carolina*) and sora (*Porzana Carolina*). At fairly large shallow wetlands with muddy shores, such as in field 1 and 4, observations were made of large numbers of foraging shorebirds and ducks, including the black-necked stilt (*Himantopus mexicanus*), northern pintail (*Anas acuta*), and American green-winged teal (*Anas crecca*).

The availability of suitable breeding habitat is a major limiting factor for plains spadefoot toads in Alberta (Lauzon 1999). Wetland drainage and cultivation, pesticide and herbicide use, and oil and gas activity have decreased habitat suitability and availability (Klassen 1998). Klassen (1998) emphasized the importance of small, semi-permanent and ephemeral water to the breeding activity of spadefoot toads. Thus, the

small ephemeral wetlands such as those in the drainage system of field 4, where toads were detected at several locations, are of conservation importance for plains spadefoot toads.

No bats were sighted during nighttime amphibian surveys; however, no specific survey effort for bats was made. It is unlikely that sensitive species of bats breed on the ACHDA due to a lack of suitable natural roost habitat (see Appendix II). There is potential however, that sensitive species of bats could forage over wetlands with abundant invertebrates.

Restricting development near the shoreline of Lake San Francisco and other managed wetland basins, and also along smaller ephemeral water bodies, including canal and basin spillovers, will reduce disturbance to the many sensitive and may be at risk species dependent on wetland and wetland fringe habitats. It is important to note that many wetland associated species, such as the northern pintail, also require a matrix of well managed wetland and upland habitat (Podruzney et al. 2002).

4.2 Upland habitats

The conservation of native mixed-grass prairie is critical to several sensitive upland songbird species (Davis 2004, Koper and Schmiegelow 2006b, Davis et al. 2006). Fragmentation from road development in prairie habitats can reduce upland songbird species richness (Koper and Schmiegelow 2006b). The Sprague's pipit (*Anthus spragueii*) is reliant on large areas of native grassland (Davis 2004, Davis et al. 2006) and is less abundant along roads (Sutter et al. 1999). Baird's sparrow (*Ammodramus bairdii*) density increases with distance from non-native habitat (Koper and Schmiegelow 2006b). Furthermore, Davis (2004) identifies that even within smaller grassland patches, the more attractive patches to sensitive species are those with a low proportion of edge habitat relative to interior habitat. To benefit sensitive upland songbirds, including the Baird's sparrow and Sprague's pipit, the relatively contiguous upland habitats in field 4 and field 1 should be left intact by (1) avoiding any further fragmentation from road and trail development, and (2) limiting development that will remove or divide upland habitat through structures and extensive human activity.

While no active burrowing owl nests were found during the 2007 survey, records of burrowing owl activity from October 2004 (Alberta Sustainable Resource Development, unpublished data) indicate that the ACHDA is used for roosting and foraging during the fall, a time period outside the scope of this survey. The most recent record of an active burrowing owl nest site on the ACHDA was in 1993 (Alberta Sustainable Resource Development, unpublished data). Current grazing regimes promote relatively tall vegetation in the native grass and idle fields. Burrowing owls effectively forage in habitats with denser taller vegetation, such as in ephemeral wetland areas that support populations of small mammal prey items (Alberta Sustainable Resource Development and Alberta Conservation Association 2005). Thus, the matrix of wetlands and thick cover available on the ACHDA supports the management goal of providing high quality forage habitat for burrowing owls. Furthermore, maintaining dense vegetation near shorelines and ephemeral wetland habitats will benefit other sensitive predators, such as the short-eared owl (*Asio flammeus*), northern harrier (*Circus cyaneus*), and long-tailed weasel. Limited prey availability, due to loss of wetland edge habitats, has contributed to population declines of long-tailed weasels (Gehring and Swihart 2004). Short-eared owl distribution is also highly dependent upon prey availability (Clayton 2000, Poulin et al. 2001).

There is however, a lack of suitable nesting habitat for the burrowing owl on the ACHDA. The high state of range health throughout the ACHDA supports tall thick vegetation. Burrowing owls, however, typically nest in areas with short (<10 cm) sparse vegetation (Alberta Sustainable Resource Development and Alberta Conservation Association 2005). The dense vegetation on the ACHDA also limits the Richardson's ground squirrel (*Spermophilus richardsonii*) that prefers habitats with short and medium grass (Downey et al. 2006). Richardson's ground squirrels are important food for sensitive species such as the ferruginous hawk and American badger. Furthermore, the burrows of the Richardson's ground squirrel and the American badger provide nest sites for the burrowing owl.

Grazing management can be used to provide opportunities for sensitive species by creating a matrix of upland habitat types on the ACHDA. Establishing some areas with shorter sparser vegetation, particularly near locations with historic burrowing owl nest

sites or current Richardson ground squirrel activity, may encourage nesting by burrowing owls on the ACHDA. Vegetation that promotes the Richardson's ground squirrel could also attract sensitive species like the ferruginous hawk and American badger.

In Alberta, loggerhead shrikes are limited by suitable breeding habitat (Prescott and Collister 1993). Management for tall grass by reducing the grazing pressure of cattle around areas with silver buffaloberry shrubs will increase availability of breeding habitat (Prescott and Collister 1993). Because the NW and NE idle fields on the ACHDA are managed for tall nesting cover, they contain the tall grass required by loggerhead shrikes. Although no nest sites were observed, the loggerhead shrike activity and apparent available nesting habitat in the NE and NW idle fields indicates these areas are a priority for loggerhead shrike conservation on the ACHDA. When clearing obstructive brush in and around canals, leaving areas with silver buffaloberry bushes intact will protect this nesting habitat for loggerhead shrikes.

4.3 Noise

Many prairie bird and amphibian species rely on songs and calls for breeding displays and communication. Chronic noise can change the age structure and reduce the pairing success of songbirds (Habib et al. 2007). Non-passerine species can also be impacted by noise. For example, courtship behaviour in harlequin ducks (*Histrionicus histrionicus*) has been reduced for over an hour following noise from military jets (Goudie and Jones 2004). In a prairie system, Holloran (2005) identified that noise intensity at leks (breeding sites) negatively affected the greater sage-grouse (*Centrocercus urophasianus*). Noise could be a significant stressor to wildlife populations on the ACHDA, however, research into the specific effects of chronic noise on prairie birds and amphibians is extremely limited. The cumulative noise at a site, including noise with a source outside the ACHDA, should be considered when planning development in areas with sensitive species. Furthermore, implementing noise reduction technologies for both new and existing developments could potentially reduce the negative consequences of these structures on sensitive wildlife. The cooperative management of the ACHDA presents an opportunity to encourage research of anthropogenic noise in prairie upland and wetland habitats.

4.4 Monitoring strategy

Long-term monitoring will guide management efforts by tracking changes in species abundance and species occurrence. Future survey efforts should use standardized methodology and survey locations to increase the interpretability of survey results through time.

The calling, timing and location of breeding can be irregular for plains spadefoot toads in Alberta (Klassen 1998). If a spring is dry or does not have heavy rains, spadefoot toads may not call or breed at all that year. Monitoring efforts should therefore occur in the days immediately following heavy spring rains (Lauzon 1999). Due to the reliance on weather conditions for plains spadefoot toad detection, annual surveys are recommended so that years with calling activity are not missed. Annual participation by the ACHDA in the Alberta Volunteer Amphibian Monitoring Program coordinated by the Alberta Conservation Association is encouraged.

REFERENCES

Alberta Sustainable Resource Development and Alberta Conservation Association. 2005. Status of the burrowing owl (*Athene cunicularia*) in Alberta: update 2005. Alberta Sustainable Resource Development, Wildlife Status Report No. 11 (Update 2005), Edmonton, AB. 28 pp.

Alberta Sustainable Resource Development and Alberta Conservation Association. 2006 Status of the ferruginous hawk (*Buteo regalis*) in Alberta: update 2006. Alberta Sustainable Resource Development, Wildlife Status Report No. 18 (Update 2006), Edmonton, AB. 22 pp.

Alberta Sustainable Resource Development. 2005. Draft Sensitive Species Inventory Guidelines (SSIG). Alberta Sustainable Resource Development. [Online, updated January 2007] URL:www.srd.gov.ab.ca/fishwildlife/guidelinesresearch/inventoryguidelines.aspx

Alberta Sustainable Resource Development. 2007. The 2005 general status of Alberta wild species. [Online, updated January 2007] URL:http://www.srd.gov.ab.ca/fw/wildspecies/index.htm

Alberta Sustainable Resource Development. 2007b. Species Currently Listed under the Wildlife Act and new Species Assessed by the ESCC. [Online, updated December 2007] URL:http://www.srd.gov.ab.ca/fishwildlife/escc/currentlylisted.aspx

Clayton, K. M. 2000. Status of the Short-eared Owl (*Asio flammeus*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 28, Edmonton, AB. 15 pp.

Davis, S.K. 2004. Area sensitivity in grassland passerines: effects of patch size, patch shape, and vegetation structure on bird abundance and occurrence in southern Saskatchewan. The Auk 121: 1130-1145.

Davis, S.K., R.M. Brigham, T.L. Shaffer, and P.C. James. 2006. Mixed-grass prairie passerines exhibit weak and variable responses to patch size. The Auk 123:807-821.

Downey, B.A., P.F. Jones, R.W. Quinlan, G.J. Scrimgeour. 2006. Use of playback alarm calls to detect and quantify habitat use by Richardson's ground squirrels. Wildlife Society Bulletin 34: 480-484.

DUC 2007. Antelope Creek Habitat Development: A model for conservation management of mixed grass prairie. Ducks Unlimited Canada (DUC). [Online, accessed 2007] URL:http://www.ducks.ca/province/ab/projects/antelope/index.html

Gehring, T.M., and R.K. Swihart. 2004. Home range and movements of long-tailed weasels in a landscape fragmented by agriculture. Journal of Mammology 85:79-86.

Gibbs, J.P. 2000. Wetland loss and biodiversity conservation. Conservation Biology 14:314-317.

Goudie, R.I. and I.L. Jones. 2004. Dose-response relationships of harlequin duck behaviour to noise from low-level military jet over-flight in central Labrador. Environmental Conservation 31:289-298.

Guyn K., and R.G. Clark. 1999. Factors affecting survival of northern pintail ducklings in Alberta. The Condor 101:369-377.

Habib, L., E.M. Bayne, and S. Boutin. 2007. Chronic industrial noise affects pairing success and age structure of ovenbirds *Seirus aurocapilla*. Journal of Applied Ecology 44:176-184.

Holloran, M.J. 2005. Greater Sage-Grouse (*Centrocercus urophasianus*) population response to natural gas field development in western Wyoming. PhD Dissertation. University of Wyoming, Laramie.

Koper, N., and F.K.A. Scmiegelow. 2006a. A multi-scaled analysis of avian response to habitat amount and fragmentation in the Canadian dry mixed-grass prairie. Landscape Ecology 21:1045-1059.

Koper N., and F.K.A. Schmiegelow. 2006b. Effects of habitat management for ducks on target and nontarget species. The Journal of Wildlife Management 70:823-834.

Klassen, M. A. 1998. Observations on the breeding and development of the Plains Spadefoot, Scaphiopus bombifrons, in southern Alberta. Canadian Field-Naturalist 112:387-392.

Lauzon, R. D. 1999. Status of the Plains Spadefoot (Spea bombifrons) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 25, Edmonton, AB. 17 pp.

Murkin, H. R., E. J. Murkin, and J. P. Ball. 1997. Avian habitat selection and prairie wetland dynamics: A 10-year experiment. Ecological Applications 7(4):1144-1159.

Pattie D. and C. Fisher. 1999. Mammals of Alberta. Lone Pine Publishing, Edmonton, AB. 240 pp.

Podruzny, K.M., J.H. Devries, L.M. Armstrong, and J.J. Rotella. 2002. Long-term response of northern pintails to changes in wetlands and agriculture in the Canadian prairie pothole region. The Journal of Wildlife Management 66:993-1010.

Poulin, R.G., T.I. Wellicome, and L.D. Todd. 2001. Synchronous and delayed numerical responses of a predatory bird community to a vole outbreak on the Canadian prairies. Journal of Raptor Research 35:288-295.

Prescott, D.R.C and D. M. Collister. 1993. Characteristics of Occupied and Unoccupied Loggerhead Shrike Territories in Southeastern Alberta. The Journal of Wildlife Management 57:346-352.

Sutter, G.C., S.K. Davis, and D.C. Duncan. 1999. Grassland songbird abundance along roads and trails in southern Saskatchewan. Journal of Field Ornithology 71:110-116.

Appendix I.

List of all species observed during the 2007 survey of the ACHDA. Nomenclature and status follow The General Status of Alberta Wild Species 2005 (Alberta Sustainable Resource Development 2007).

Animal Type	*Scientific Name*	Common Name	Status
Amphibians	*Spea bombifrons*	Plains Spadefoot Toad	May Be at Risk
Amphibians	*Pseudacris maculata*	Boreal Chorus Frog	Secure
Amphibians	*Ambystoma tigrinum*	Tiger Salamander	Secure
Mammals	*Mustela frenata*	Long-tailed Weasel	May Be at Risk
Mammals	*Canis latrans*	Coyote	Secure
Mammals	*Ondatra zibethicus*	Muskrat	Secure
Mammals	*Vulpes vulpes*	Red Fox	Secure
Mammals	*Spermophilus richardsonii*	Richardson's Ground Squirrel	Secure
Mammals	*Odocoileus virginianus*	White-tailed Deer	Secure
Mammals	*Lepus townsendii*	White-tailed Jack Rabbit	Secure
Birds	*Ammodramus bairdii*	Baird's Sparrow	May Be at Risk
Birds	*Asio flammeus*	Short-eared Owl	May Be at Risk
Birds	*Botaurus lentiginosus*	American Bittern	Sensitive
Birds	*Anas crecca*	American Green-winged Teal	Sensitive
Birds	*Pelecanus erythrorhynchos*	American White Pelican	Sensitive
Birds	*Hirundo rustica*	Barn Swallow	Sensitive
Birds	*Chlidonias niger*	Black Tern	Sensitive
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron	Sensitive
Birds	*Himantopus mexicanus*	Black-necked Stilt	Sensitive
Birds	*Dolichonyx oryzivorus*	Bobolink	Sensitive
Birds	*Geothlypis trichas*	Common Yellowthroat	Sensitive
Birds	*Sterna forsteri*	Forster's Tern	Sensitive
Birds	*Ammodramus savannarum*	Grasshopper Sparrow	Sensitive
Birds	*Ardea herodias*	Great Blue Heron	Sensitive
Birds	*Aythya affinis*	Lesser Scaup	Sensitive
Birds	*Lanius ludovicianus*	Loggerhead Shrike	Sensitive
Birds	*Numenius americanus*	Long-billed Curlew	Sensitive
Birds	*Circus cyaneus*	Northern Harrier	Sensitive
Birds	*Anas acuta*	Northern Pintail	Sensitive
Birds	*Podilymbus podiceps*	Pied-billed Grebe	Sensitive
Birds	*Porzana carolina*	Sora	Sensitive
Birds	*Anthus spragueii*	Sprague's Pipit	Sensitive
Birds	*Buteo swainsoni*	Swainson's Hawk	Sensitive
Birds	*Bartramia longicauda*	Upland Sandpiper	Sensitive
Birds	*Rallus limicola*	Virginia Rail	Undetermined
Birds	*Coturnicops noveboracensis*	Yellow Rail	Undetermined
Birds	*Perdix perdix*	Gray Partridge	Exotic/Alien
Birds	*Phasianus colchicus*	Ring-necked Pheasant	Exotic/Alien
Birds	*Columba livia*	Rock Pigeon	Exotic/Alien

Continued on next page

Appendix I continued

Animal Type	*Scientific Name*	Common Name	Status
Birds	*Recurvirostra americana*	American Avocet	Secure
Birds	*Fulica americana*	American Coot	Secure
Birds	Corvus brachyrhynchos	American Crow	Secure
Birds	*Falco sparverius*	American Kestrel	Secure
Birds	*Anas americana*	American Wigeon	Secure
Birds	*Anas discors*	Blue-winged Teal	Secure
Birds	*Euphagus cyanocephalus*	Brewer's Blackbird	Secure
Birds	*Molothrus ater*	Brown-headed Cowbird	Secure
Birds	*Larus californicus*	California Gull	Secure
Birds	*Branta canadensis*	Canada Goose	Secure
Birds	*Calcarius ornatus*	Chestnut-collared Longspur	Secure
Birds	*Anas cyanoptera*	Cinnamon Teal	Secure
Birds	*Spizella pallida*	Clay-colored Sparrow	Secure
Birds	*Sterna hirundo*	Common Tern	Secure
Birds	*Phalacrocorax auritus*	Double-crested Cormorant	Secure
Birds	*Podiceps nigricollis*	Eared Grebe	Secure
Birds	*Tyrannus tyrannus*	Eastern Kingbird	Secure
Birds	*Larus pipixcan*	Franklin's Gull	Secure
Birds	*Anas strepera*	Gadwall	Secure
Birds	*Bubo virginianus*	Great Horned Owl	Secure
Birds	*Eremophila alpestris*	Horned Lark	Secure
Birds	*Charadrius vociferus*	Killdeer	Secure
Birds	*Ammodramus leconteii*	Le Conte's Sparrow	Secure
Birds	*Anas platyrhynchos*	Mallard	Secure
Birds	*Limosa fedoa*	Marbled Godwit	Secure
Birds	*Cistothorus palustris*	Marsh Wren	Secure
Birds	*Zenaida macroura*	Mourning Dove	Secure
Birds	*Ammodramus nelsoni*	Nelson's Sharp-tailed Sparrow	Secure
Birds	*Anas clypeata*	Northern Shoveler	Secure
Birds	*Vireo olivaceus*	Red-eyed Vireo	Secure
Birds	*Aythya americana*	Redhead	Secure
Birds	*Podiceps grisegena*	Red-necked Grebe	Secure
Birds	*Agelaius phoeniceus*	Red-winged Blackbird	Secure
Birds	*Larus delawarensis*	Ring-billed Gull	Secure
Birds	*Oxyura jamaicensis*	Ruddy Duck	Secure
Birds	*Passerculus sandwichensis*	Savannah Sparrow	Secure
Birds	*Pooecetes gramineus*	Vesper Sparrow	Secure
Birds	*Tyrannus verticalis*	Western Kingbird	Secure
Birds	*Sturnella neglecta*	Western Meadowlark	Secure
Birds	*Catoptrophorus semipalmatus*	Willet	Secure
Birds	*Phalaropus tricolor*	Wilson's Phalarope	Secure
Birds	*Gallinago delicata*	Wilson's Snipe	Secure
Birds	*Xanthocephalus xanthocephalus*	Yellow-headed Blackbird	Secure

Appendix II.

The At Risk, May Be at Risk, and Sensitive mammals listed in The General Status of Alberta Wildlife 2005 (Alberta Sustainable Resource Development 2007). Current species range was determined by comparison with range maps in Pattie and Fisher (1999). The presence of a species record is derived from both this survey and previous records (Alberta Sustainable Resource Development, unpublished data).

Within current species range	Existing species record	Potential for use of the ACHDA	Common Name	Scientific Name	Status
Yes	Yes	Yes	Long-tailed Weasel	*Mustela frenata*	May Be at Risk
			Pronghorn	*Antilocapra americana*	Sensitive
			American Badger	*Taxidea taxus*	Sensitive
	No	Lack of roost habitat. Some potential as a foraging site.	Hoary Bat	*Lasiurus cinereus*	Sensitive
			Red Bat	*Lasiurus borealis*	Sensitive
			Silver-haired Bat	*Lasionycteris noctivagans*	Sensitive
			Western Small-footed Bat	*Myotis ciliolabrum*	Sensitive
No	No	No	Bobcat	*Lynx rufus*	Sensitive
			Fisher	*Martes pennanti*	Sensitive
			Olive-backed Pocket Mouse	*Perognathus fasciatus*	Sensitive
			Red-tailed Chipmunk	*Tamias ruficaudus*	Sensitive
			Water Vole	*Microtus richardsoni*	Sensitive
			Canada Lynx	*Lynx canadensis*	Sensitive
			Northern Long-eared Bat	*Myotis septentrionalis*	May Be at Risk
			Vagrant Shrew	*Sorex vagrans*	May Be at Risk
			Wolverine	*Gulo gulo*	May Be at Risk
			Grizzly Bear	*Ursus arctos*	May Be at Risk
			Ord's Kangaroo Rat	*Dipodomys ordii*	At Risk
			Swift Fox	*Vulpes velox*	At Risk
			Woodland Caribou	*Rangifer tarandus caribou*	At Risk
			Wood Bison	*Bos bison athabascae*	At Risk

Appendix III.

Locations of upland point counts given as an UTM Easting and Northing in Zone 12, map datum NAD 83. Plot codes consist of field name or number followed by the plot number within that field, and finally the habitat type.

Plot Code	Easting	Northing
1-1-upland	415421	5606823
1-2-upland	415219	5606604
1-3-upland	415095	5606331
1-4-upland	415030	5606036
1-5-upland	415428	5605900
1-6-upland	415336	5605610
1-7-upland	415320	5605304
1-8-upland	415933	5606173
1-9-upland	416118	5606411
1-10-upland	415812	5607510
2-1-upland	417214	5605739
2-2-upland	417318	5606009
2-3-upland	417700	5606370
2-4-upland	417270	5606763
2-5-upland	417700	5607050
2-6-upland	417413	5607622
2-7-upland	417712	5607641
2-8-upland	418071	5606754
3-1-upland	417560	5604059
3-2-upland	417407	5604174
3-3-upland	417124	5604263
3-4-upland	417097	5604573
3-6-upland	418839	5603760
3-7-upland	418990	5603500
3-8-upland	419154	5603243
3-9-upland	418140	5603552
3-10-upland	418450	5603552
3-11-upland	418750	5603530
3-12-upland	416980	5605027
3-14-upland	417393	5603242
3-15-upland	417350	5603050
3-16-upland	417090	5603211
4-2-upland	416344	5604375
4-4-upland	416121	5604184
4-5-upland	416574	5604573
4-7-upland	416652	5603312
4-8-upland	416359	5603298

Plot Code	Easting	Northing
4-9-upland	416062	5603300
4-10-upland	415447	5603902
4-11-upland	415216	5603715
4-12-upland	414990	5603515
4-13-upland	414762	5603322
4-14-upland	415313	5603093
4-15-upland	415083	5603213
4-16-upland	416683	5604946
cassils-1-upland	421243	5604311
cassils-2-upland	421228	5604614
cassils-3-upland	421480	5604545
cassils-4-upland	421553	5604282
cassils-5-upland	421770	5604643
cassils-6-upland	422140	5604736
cassils-7-upland	422167	5604341
grazed-1-upland	420133	5603140
grazed-2-upland	419986	5603300
grazed-3-upland	419903	5603338
home-1-upland	418565	5605073
ne idle-1-upland	418385	5607239
nw idle-1-upland	416357	5607401
nw idle-2-upland	416500	5607678
oakland-1-upland	416929	5608631
oakland-2-upland	417225	5608565
oakland-3-upland	417511	5608501
oakland-4-upland	417806	5608439
oakland-6-upland	417403	5608067
oakland-7-upland	417116	5608146
oakland-8-upland	416818	5608226
oakland-9-upland	416280	5608086
oakland-10-upland	416402	5608372
oakland-11-upland	416507	5608658
oakland-12-upland	416192	5608810
oakland-13-upland	415998	5608583
oakland-14-upland	415809	5608353
oakland-15-upland	415617	5608124

Appendix IV.

Locations of wetland counts given as an UTM Easting and Northing in Zone 12, map datum NAD 83. Plot codes consist of field name or number followed by the plot number within that field, and finally the habitat type.

Plot Code	Easting	Northing
1-1-wetland	415554	5606960
1-5-wetland	415550	5605881
1-8-wetland	415847	5606109
1-10-wetland	415812	5607390
2-1-wetland	417190	5605630
2-2-wetland	417392	5606105
2-3-wetland	417635	5606291
2-3b-wetland	417794	5606481
2-6-wetland	417311	5607606
2-8-wetland	417[illegible]78	5606715
3-1-wetland	417608	5603946
3-5-wetland	417438	5604779
3-6-wetland	418786	5603844
3-8-wetland	419189	5603077
3-9-wetland	418040	5603540
3-12-wetland	417104	5605033
4-4-wetland	416051	5604114
4-9-wetland	415962	5603300
4-10-wetland	415286	5603785
cassils-2-wetland	421245	5604715
cassils-3-wetland	421480	5604650
cassils-5-wetland	421770	5604745
cassils-6-wetland	422141	5604822
grazed-1-wetland	420190	5603230
home-1-wetland	418767	5605274
ne idle-1-wetland	418455	5607307
nw idle-1-wetland	416457	5607400
nw idle-2-wetland	416400	5607678
oakland-4-wetland	417906	5608382
oakland-5-wetland	417900	5608053
oakland-9-wetland	416220	5607980

Appendix V.

Locations of amphibian counts given as an UTM Easting and Northing in Zone 12, map datum NAD 83. Foot accessed plots match the naming of avian point counts. Road accessed points are numbered arbitrarily as a road route.

Plot Code	Easting	Northing
1-1-wetland	415554	5606960
1-5-wetland	415550	5605881
1-8-wetland	415847	5606109
1-10-wetland	415812	5607390
2-1-wetland	417190	5605630
2-2-wetland	417392	5606105
2-3-wetland	417635	5606291
2-3b-wetland	417794	5606481
2-6-wetland	417311	5607606
2-8-wetland	417978	5606715
3-1-wetland	417608	5603946
3-5-wetland	417438	5604779
3-6-wetland	418786	5603844
3-8-wetland	419189	5603077
3-9-wetland	418040	5603540
3-12-wetland	417104	5605033
4-4-wetland	416051	5604114
4-9-wetland	415962	5603300
4-10-wetland	415286	5603785
cassils-2-wetland	421245	5604715
cassils-3-wetland	421480	5604650
cassils-5-wetland	421770	5604745
cassils-6-wetland	422141	5604822
grazed-1-wetland	420190	5603230
home-1-wetland	418767	5605274
ne idle-1-wetland	418455	5607307
nw idle-1-wetland	416457	5607400
nw idle-2-wetland	416400	5607678
oakland-4-wetland	417906	5608382
oakland-5-wetland	417900	5608053
oakland-9-wetland	416220	5607980
Road Route-1	415877	5603872
Road Route-2	416874	5604193
Road Route-3	416072	5603937
Road Route-4	415588	5604056

Plot Code	Easting	Northing
Road Route-5	421930	5604780
Road Route-6	420137	5603617
Road Route-7	419366	5604008
Road Route-8	419315	5604115
Road Route-9	418547	5604943
Road Route-10	416188	5607463
Road Route-11	416378	5607279
Road Route-12	420190	5603230
Road Route-13	416190	5607460
Road Route-14	417245	5607150
Road Route-15	416891	5606128
Road Route-16	418168	5604257
Road Route-17	419480	5603358
Road Route-18	418618	5603216
Road Route-19	418213	5603453
Road Route-20	418213	5603890
Road Route-21	416188	5607463
Road Route-22	417312	5607191
Road Route-23	416880	5605200
Road Route-24	418003	5603474
Road Route-25	415877	5603872
Road Route-26	416874	5604193
Road Route-27	416072	5603937
Road Route-28	415588	5604056
Road Route-29	415292	5604471
Road Route-30	421930	5604780
Road Route-31	420137	5603617
Road Route-32	419366	5604008
Road Route-33	419315	5604115
Road Route-34	418547	5604943
Road Route-35	416188	5607463
Road Route-36	417312	5607191
Road Route-37	416880	5605200
Road Route-38	418003	5603474
Road Route-39	415292	5604471

List of Titles in This Series
(as of March 2008)

No. 1 Alberta species at risk program and projects 2000-2001, by Alberta Sustainable Resource Development, Fish and Wildlife Division. (2001)

No. 2 Survey of the peregrine falcon (*Falco peregrinus anatum*) in Alberta, by R. Corrigan. (2001)

No. 3 Distribution and relative abundance of the shortjaw cisco (*Coregonus zenithicus*) in Alberta, by M. Steinhilber and L. Rhude. (2001)

No. 4 Survey of the bats of central and northwestern Alberta, by M.J. Vonhof and D. Hobson. (2001)

No. 5 2000 survey of the Trumpeter Swan (*Cygnus buccinator*) in Alberta, by M.L. James and A. James. (2001)

No. 6 2000/2001 Brassy Minnow inventory at Musreau Lake and outlet, by T. Ripley. (2001)

No. 7 Colonial nesting waterbird survey in the Northwest Boreal Region – 2000, by M. Hanneman and M. Heckbert. (2001)

No. 8 Burrowing owl trend block survey and monitoring - Brooks and Hanna areas, by D. Scobie and R. Russell. (2000)

No. 9 Survey of the Lake Sturgeon (*Acipenser fulvescens*) fishery on the South Saskatchewan River, Alberta (June-September, 2000), by L.A. Winkel. (2000)

No. 10 An evaluation of grizzly bear-human conflict in the Northwest Boreal Region of Alberta (1991-2000) and potential mitigation, by T. Augustyn. (2001)

No. 11 Harlequin duck monitoring in the Northern East Slopes of Alberta: 1998-2000 preliminary results, by J. Kneteman and A. Hubbs. (2000)

No. 12 Distribution of selected small mammals in Alberta, by L. Engley and M. Norton. (2001)

No. 13 Northern leopard frog reintroduction. Raven River - Year 2 (2000), by K. Kendell. (2001)

No. 14 Cumulative effects of watershed disturbances on fish communities in the Kakwa and Simonette watersheds. The Northern Watershed Project. Study 3 Progress report, by T. Thera and A. Wildeman. (2001)

No. 15 Harlequin duck research in Kananaskis Country in 2000, by C.M. Smith. (2001)

No. 16 Proposed monitoring plan for harlequin ducks in the Bow Region of Alberta, by C.M. Smith. (2001)

No. 17 Distribution and relative abundance of small mammals of the western plains of Alberta as determined from great horned owl pellets, by D. Schowalter. (2001)

No. 18 Western blue flag (*Iris missouriensis*) in Alberta: a census of naturally occurring populations for 2000, by R. Ernst. (2000)

No. 19 Assessing chick survival of sage grouse in Canada, by C.L. Aldridge. (2000)

No. 20 Harlequin duck surveys of the Oldman River Basin in 2000, by D. Paton. (2000)

No. 21 Proposed protocols for inventories of rare plants of the Grassland Natural Region, by C. Wallis. (2001)

No. 22 Utilization of airphoto interpretation to locate prairie rattlesnake (*Crotalus viridis viridis*) hibernacula in the South Saskatchewan River valley, by J. Nicholson and S. Rose. (2001)

No. 23 2000/2001 Progress report on caribou research in west central Alberta, by T. Szkorupa. (2001)

No. 24 Census of swift fox (*Vulpes velox*) in Canada and Northern Montana: 2000-2001, by A. Moehrenschlager and C. Moehrenschlager. (2001)

No. 25 Population estimate and habitat associations of the long-billed curlew in Alberta, by E.J. Saunders. (2001)

No. 26 Aerial reconnaissance for piping plover habitat in east-central Alberta, May 2001, by D.R.C. Prescott. (2001)

No. 27 The 2001 international piping plover census in Alberta, by D.R.C. Prescott. (2001)

No. 28 Prairie rattlesnake (*Crotalus viridis viridis*) monitoring in Alberta – preliminary investigations (2000), by S.L. Rose. (2001)

No. 29 A survey of short-horned lizard (*Phrynosoma hernandesi hernandesi*) populations in Alberta, by J. James. (2001)

No. 30 Red-sided garter snake (*Thamnophis sirtalis parietalis*) education and relocation project – final report, by L. Takats. (2002)

No. 31 Alberta furbearer harvest data analysis, by K.G. Poole and G. Mowat. (2001)

No. 32 Measuring wolverine distribution and abundance in Alberta, by G. Mowat. (2001)

No. 33 Woodland caribou (*Rangifer tarandus caribou*) habitat classification in northeastern Alberta using remote sensing, by G.A. Sanchez-Azofeifa and R. Bechtel. (2001)

No. 34 Peregrine falcon surveys and monitoring in the Parkland Region of Alberta, 2001, by R. Corrigan. (2002)

No. 35 Protocol for monitoring long-toed salamander (*Ambystoma macrodactylum*) populations in Alberta, by T. Pretzlaw, M. Huynh, L. Takats and L. Wilkinson. (2002)

No. 36 Long-toed salamander (*Ambystoma macrodactylum*) monitoring study in Alberta: summary report 1998-2001, by M. Huynh, L. Takats and L. Wilkinson. (2002)

No. 37 Mountain plover habitat and population surveys in Alberta, 2001, by C. Wershler and C. Wallis. (2002)

No. 38 A census and recommendations for management for western blue flag (*Iris missouriensis*) in Alberta, by R. Ernst. (2002)

No. 39 Columbian mountain amphibian surveys, 2001, by D. Paton. (2002)

No. 40 Management and recovery strategies for the Lethbridge population of the prairie rattlesnake, by R. Ernst. (2002)

No. 41 Western (*Aechmophorus occidentalis*) and eared (*Podiceps nigricollis*) grebes of central Alberta: inventory, survey techniques and management concerns, by S. Hanus, H. Wollis and L. Wilkinson. (2002)

No. 42 Northern leopard frog reintroduction – year 3 (2001), by K. Kendell. (2002)

No. 43 Survey protocol for the northern leopard frog, by K. Kendell. (2002)

No. 44 Alberta inventory for the northern leopard frog (2000-2001), by K. Kendell. (2002)

No. 45 Fish species at risk in the Milk and St. Mary drainages, by RL&L Environmental Services Ltd. (2002)

No. 46 Survey of the loggerhead shrike in the southern aspen parkland region, 2000-2001, by H. Kiliaan and D.R.C. Prescott. (2002)

No. 47 Survey of native grassland butterflies in the Peace parkland region of northwestern Alberta – 2001, by M. Hervieux. (2002)

No. 48 Caribou range recovery in Alberta: 2001/02 pilot year, by T. Szkorupa. (2002)

No. 49 Peace parkland native grassland stewardship program 2001/02, by A. Baker. (2002)

No. 50 Carnivores and corridors in the Crowsnest Pass, by C. Chetkiewicz. (2002)

No. 51 2001 Burrowing owl trend block survey and monitoring, Brooks and Hanna areas, by D. Scobie. (2002)

No. 52 An evaluation of the ferruginous hawk population in Alberta based on recent trend data, by D.P. Stepnisky, G.L. Erickson, J. Iwaasa and B. Taylor. (2002)

No. 53 Alberta amphibian call surveys. A pilot year. Final report, by L. Takats and C. Priestley. (2002)

No. 54 Utilization of a roadside survey technique to survey burrowing owl (*Athene cunicularia hypugaea*) in southeastern Alberta, by J. Nicholson and C. Skiftun. (2002)

No. 55 Alberta species at risk program and projects 2001-2002, by Alberta Sustainable Resource Development, Fish and Wildlife Division. (2002)

No. 56 Developing a habitat-based population viability model for greater sage-grouse in southeastern Alberta, by C.L. Aldridge. (2001)

No. 57 Peregrine falcon surveys and monitoring in the Northeast Boreal Region of Alberta, 2001, by R. Corrigan. (2002)

No. 58 2002 burrowing owl trend block survey and monitoring, Brooks area, by R.F. Russell. (2002)

No. 59 Rare plant inventory of the eastern edge of the lower foothills natural subregion, west-central Alberta, by J. Doubt. (2002)

No. 60 Western (*Aechmophorus occidentalis*) and eared (*Podiceps nigricollis*) grebes of central Alberta: 2002 field summary, by S. Hanus, L. Wilkinson and H. Wollis. (2002)

No. 61 Inventory of western spiderwort (*Tradescantia occidentalis*) in Alberta: 2002, by S. Peters. (2003)

No. 62 Bullsnakes (*Pituophis catenifer sayi*) in Alberta: literature review and data compilation, by K.J. Kissner and J. Nicholson. (2003)

No. 63 Distribution of Ord's kangaroo rats in southeastern Alberta, by D.L. Gummer and S.E. Robertson. (2003)

No. 64 Lethbridge prairie rattlesnake conservation project: 2002/2003 progress report, by R.D. Ernst. (2003)

No. 65 Short-horned lizard (*Phrynosoma hernandesi hernandesi*) populations in Alberta – 2002 survey results, by J.D. James. (2003)

No. 66 Inventory and monitoring protocol for naturally occurring western blue flag (*Iris missouriensis*) in Alberta, by R.D. Ernst. (2003)

No. 67 The use of call playbacks for censusing loggerhead shrikes in southern Alberta, by D.R.C. Prescott. (2003)

No. 68 Survey of bats in northeastern Alberta, by A. Hubbs and T. Schowalter. (2003)

No. 69 Survey protocol for the Richardson's ground squirrel, by B.A. Downey. (2003)

No. 70 Population estimates and a survey protocol for ferruginous hawks in Alberta, by B.N. Taylor. (2003)

No. 71 Testing methods for detecting wolverine, by G. Mowat, C. Kyle and D. Paetkau. (2003)

No. 72 A multi-species conservation strategy for species at risk in the Milk River basin: year 1 progress report, by R.W. Quinlan, B.A. Downey, B.N. Taylor, P.F. Jones and T.B. Clayton. (2003)

No. 73 Long-toed salamander (*Ambystoma macrodactylum*) conservation in the Alberta foothills: 2002 field summary report, by L. Wilkinson and S. Hanus. (2003)

No. 74 Researching Amphibian Numbers in Alberta (RANA): 2002 provincial summary, by L. Wilkinson and S. Hanus. (2003)

No. 75 Distribution and habitat associations of the long-toed salamander (*Ambystoma macrodactylum*) in the Oldman River drainage, by K. Pearson. (2003)

No. 76 Prairie rattlesnake (*Crotalus viridis*) hibernacula: monitoring history in Alberta 1987-2002, by K.J. Kissner and J. Nicholson. (2003)

No. 77 Alberta species at risk program and projects 2002-2003, by Alberta Sustainable Resource Development, Fish and Wildlife Division. (2003)

No. 78 Northern leopard frog reintroduction: Year 4 (2002), by K. Kendell. (2003)

No. 79 Magrath Northern Leopard Frog Reintroduction Project - Year 1 Progress Report, by K.A. Romanchuck. (2003)

No. 80 Conservation Overview of Butterflies in the Southern Headwaters at Risk Project (SHARP) Area, by N. Kondla. (2004)

No. 81 Lethbridge Rattlesnake Conservation Project: 2003 Progress Report, by R. Ernst. (2004)

No. 82 Shortjaw Cisco Species at Risk Assessment 2001, by M. Steinhilber. (2004)

No. 83 Researching Amphibian Numbers in Alberta (RANA): 2003 provincial summary, by L. Wilkinson and K. Kempin. (2004)

No. 84 Methods for Controlling Depredation on Piping Plovers in Alberta: A Literature Review and Synthesis, by R. Schmelzeisen, D.R.C. Prescott and L. Engley. (2004)

No. 85 Western Blue Flag Conservation Program: 3-Year Summary Report, by K.A. Romanchuk, R.D. Ernst, and R.W Quinlan (2004)

No. 86 MULTISAR: The Milk River Basin Habitat Suitability Models for Selected Wildlife Management Species, by B. A. Downey, B. L. Downey, R. W. Quinlan, O. Castelli, V. Remesz and P. F. Jones (eds.). (2004)

No. 87 MULTISAR: The Milk River Basin, A Multi-Species Conservation Strategy For Species at Risk: Year 2-Progress Report, by R.W. Quinlan, B. A. Downey, B. L. Downey, and P. F. Jones. (2004)

No. 88 Survey of Colonial Nesting Birds and Lakeshore Habitats in Northeast Alberta, by C. Found and A. Hubbs. (2004)

No. 89 The southern headwaters at risk project: A multi-species conservation strategy for the headwaters of the Oldman River. Volume 1: Introduction and natural processes, by F. Blouin. (2004)

No. 90 The southern headwaters at risk project: A multi-species conservation strategy for the headwaters of the Oldman River. Volume 2: Species Selection and Habitat Suitability Models, by F. Blouin, B.N.Taylor, and R.W.Quinlan (eds). (2004)

No. 91 Distribution, abundance and habitat selection of northern pygmy and barred owls along the eastern slopes of the Alberta Rocky Mountains, by M. D. Piorecky and D. R. C. Prescott. (2004)

No. 92 Survey of Aquatic Gastropods in the Central Parkland Subregion of Alberta, by D. R. C. Prescott, and M. M. Curteanu. (2004)

No. 93 The 2003 Loggerhead Shrike Survey in Alberta, by D. R. C. Prescott. (2004)

No. 94 Western (*Aechmophorus occidentalis*) and Eared (*Podiceps nigricollis*) Grebes of Central and Parkland Alberta: 2004 Field Summary, by G. Berg, L. Wilkinson, H. Wollis, and D. Prescott. (2004)

No. 95 Researching Amphibian Numbers in Alberta (RANA): 2004 provincial summary, by L. Wilkinson and G. Berg. (2004)

No. 96 Gillett's checkerspot in the southern headwaters at risk (SHARP) project area, by N.G. Kondla. (2005)

No. 97 Southern headwaters at risk project (SHARP) amphibian and western painted turtle (Chrysemys picta) surveys, 2003-2004, by K.J. Pearson. (2005)

No. 98 MULTISAR: A Multi-Species Conservation Strategy For Species at Risk: Year 3 Report, by B. L. Downey, B. A. Downey, R.W. Quinlan, and P. F. Jones. (2005)

No. 99 Implementation of the Alberta Piping Plover Recovery Plan, 2002-2004: Final Program Report. Alberta Piping Plover Recovery Team. (2005)

No. 100 Alberta Species at Risk Program and Projects 2003-2004, by Alberta Sustainable Resource Development, Fish and Wildlife Division. (2005)

No. 101. The 2005 ferruginous hawk inventory and population analysis, by B. L. Downey. (2005)

No. 102 Western Spiderwort (*Tradescantia occidentalis*) Inventory in Alberta, 2005, by B.L. Remarchuk. (2006)

No. 103 Reproductive Biology of Female Prairie Rattlesnakes (*Crotalus viridis viridis*) in Alberta, by D. Jorgenson. (2007)

No. 104 Magrath Northern Leopard Frog Reintroduction Program: Final Report, by K. Romanchuk and R. Quinlan. (2005)

No. 105 The Southern Headwaters at Risk Project: A Multi-Species Conservation Strategy for the Headwaters of the Oldman River, Volume 3, Landscape Management - Selection and Recommendations, by F. Blouin. (2006)

No. 106 The Southern Headwaters at Risk Project: A Multi-Species Conservation Strategy for the Headwaters of the Oldman River Volume 4, BMP's and Land Use Guidelines for Focal Species, by F. Blouin. (2006)

No. 107 The Southern Headwaters at Risk Project: A Multi-Species Conservation Strategy for the Headwaters of the Oldman River, Volume 5, Landscape Pressures on Wide-ranging Species, by F. Blouin. (2006)

No. 108 MULTISAR: A Multi-Species Conservation Strategy for Species at Risk 2005-2006 Report, by B. A. Downey, B. L. Downey, R. W. Quinlan, and P.F. Jones. (2006)

No. 109 Western Rattlers and People: Conserving rattlesnakes in Lethbridge, by R.D. Ernst and R.W. Quinlan. (2006)

No. 110 Researching Amphibian Numbers in Alberta (RANA): 2005 Provincial Summary, by L. Wilkinson and G. Berg. (2006)

No. 111 Inventory of the Pinhorn Soapweed (*Yucca glauca*) and Yucca moth (*Tegiticula yuccasella*) population, 2004, by K. Foreman, J. Chandler, and L. Matthias. (2006)

No. 113 Monitoring Protocol for the Ord's Kangaroo Rat, by D. J. Bender, D. L. Gummer, and R. Dzenkiw. (2007)

No. 114 MULTISAR: A Multi-species Conservation Strategy for Species at Risk, 2006-2007 report, by Downey, B. A., R. W. Quinlan, P. F. Jones, and R. Elhert. (2007)

No. 115 Bird Populations on the Shoreline of Buffalo Lake: Identification of Priority Areas for Conservation. by D. R. C. Prescott and S. D. Stevens. (2007)

No. 116 Burrowing Owl Population Trends on the Kininvie Blocks from 1993-2007, and Ancillary Data for Additional Species at Risk in 2007, by S. D. Stevens and A. W. Todd. (2008)

No. 117 MULTISAR: A Multi-Species Conservation Strategy for Species at Risk 2007-2008 Report, by B. L. Downey, B. A. Downey, R. W. Quinlan, P.F. Jones, S.L. Frank, D.E. Cross, D.J. Jarina, C.G. DeMaere, and J. Nicholson. (2008)